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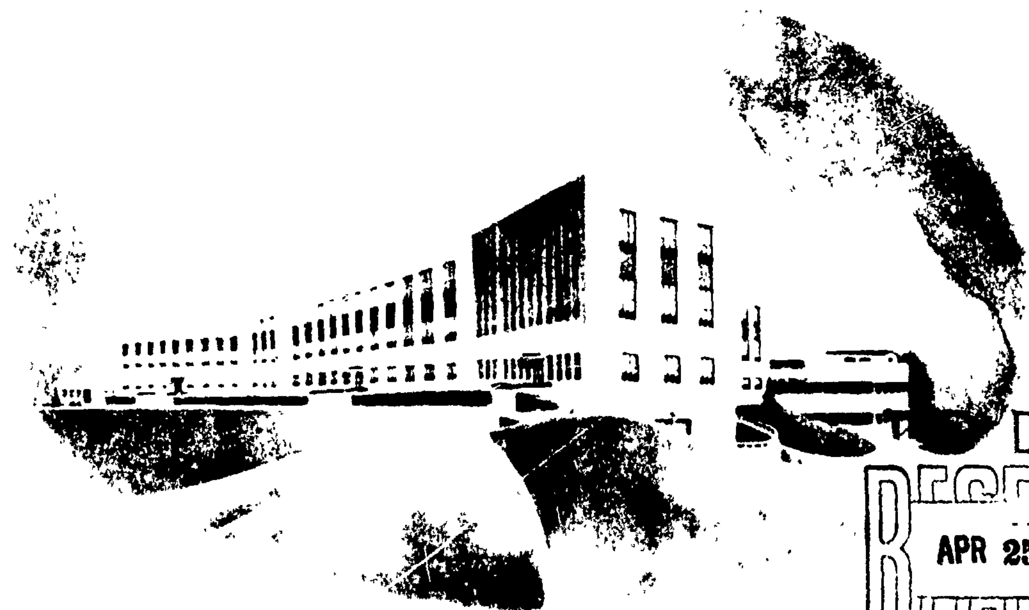

BIOCHEMICAL STUDIES DURING SATURATION DIVING:

A COMPARISON OF A SATURATION DIVE WITH

SATURATION-EXCURSION DIVES

D.E. Uddin, R.E. Danziger, T.L. Sallee,
John M. Alexander, and E.T. Flynn

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13. ABSTRACT
A number of serum constituents were measured before, during and after one saturation-excursion dive to 300 feet of sea water (FSW), two saturation-excursion dives to 600 FSW, and one saturation dive to 1000 FSW. Significant increases in creatine phosphokinase (CPK) and lactate dehydrogenase (LDH) activity were noted on both saturation-excursion profiles, however, there were essentially no changes in serum enzyme activity during the saturation dive to 1000 FSW. On all 3 profiles, serum lactic acid was elevated with the largest increase occurring on the 1000 FSW dive. No changes were noted in the serum lipid constituents on any of hese dives. These changes in serum biochemistries are discussed in relation to the differences in environmental conditions.

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Saturation-excursion						
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SUMMARY

A number of serum constituents were measured before, during, and after one saturation-excursion dive to 300 feet of sea water (FSW), two saturation-excursion dives to 600 FSW, and one saturation dive to 1000 FSW. Significant increases in creatine phosphokinase (CPK) and lactate dehydrogenase (LDH) activity were noted on both saturation-excursion profiles, however, there were essentially no changes in serum enzyme activity during the saturation dive to 1000 FSW. On all 3 profiles, serum lactic acid was elevated with the largest increase occurring on the 1000 FSW dive. No changes were noted in the serum lipid constituents on any of these dives. These changes in serum biochemistries are discussed in relation to the differences in environmental conditions.

INTRODUCTION

In a recent report, we described the results of extensive serum biochemical analysis on divers during two 600 FSW* saturation dives (1). The major changes observed were an increase in serum CPK activity and serum lactate. Others have reported decreases in serum glucose during saturation exposures (2,3). To extend these observations, similar studies were performed during a saturation-excursion dive to 300 FSW and a saturation dive to 1000 FSW. Complete results on these analyses are compared in this report as the basis for future studies.

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*Abbreviations used in this manuscript: FSW = feet of sea water, CPK = creatine phosphokinase, SGOT = glutamate oxalacetate transaminase, LDH = lactate dehydrogenase, ALK PHOS = alkaline phosphatase

METHODS

All dives were conducted in the hyperbaric chamber complex of the Navy Experimental Diving Unit, Washington, D.C. A total of 16 Navy divers, ranging in age from 23 to 37 were studied. The following dives were performed:

A. Four subjects were compressed on a mixture of helium and oxygen in the dry chamber to a simulated depth of 300 FSW at an integrated rate of 40 feet/hour (Figure 1). During the subsequent six days at 300 FSW, each subject made three excursion dives per day in the wet tank to depths ranging from 350 to 450 FSW and for exposure times ranging from 20 to 120 minutes. Compression and decompression during these excursion dives was performed at a rate of 60 feet/minute. Decompression from the saturation depth of 300 FSW followed the standard U S. Navy format (Table I).

B. Eight subjects, four on each of two successive dives, were compressed to a simulated depth of 600 FSW on a mixture of helium and oxygen in the dry chamber at an integrated rate of 40 feet/hour (Figure 2). During the subsequent six days at the saturation depth, each diver made three excursion dives per day in the wet tank to depths ranging from 650 to 750 FSW and for durations ranging from 20 to 120 minutes. Compression and decompression rates during these excursions were at a rate of 60 feet/minute. Decompression from the saturation depth of 600 FSW followed the standard U.S. Navy format. (Table I)

C. Four subjects were compressed at a rate of 5 feet/minute on a mixture of helium and oxygen to an ultimate saturation depth of 1000 FSW (Figure 3). During compression, three day intermediate stops were made at 200, 400, 600, and 800 FSW. Four days were spent at the saturation depth of 1000 FSW. Decompression was performed in accordance with Table I, with the exception of a 24 hour stop at 850 FSW to permit physiologic studies.

During these deep helium-oxygen dives, the chamber atmosphere was monitored continuously for oxygen and carbon dioxide content, temperature, and relative humidity. Oxygen concentration was maintained between 0.29 and 0.35 atmospheres, carbon dioxide content was not allowed to exceed 0.5% surface equivalent, temperature ranged from 80 to 89°F, and relative humidity from 50 to 70%. The water temperature in the wet tank was maintained between 85 and 90°F. Deviations from these limits occurred only during rapid compression and decompression. In all dives, the divers performed moderate work by swimming against a trapeze ergometer and by lifting weights on a ten minute work, five minute rest cycle. Complete descriptions of these dive profiles have been published elsewhere (4,5).

Fasting blood samples were obtained by venipuncture at 0700 hours on the days indicated (Fig. 1-3). The blood samples drawn at increased ambient pressure were decompressed at 15 feet/minute. After clotting, samples were centrifuged and the serum was withdrawn. Prior to centrifugation, samples were stored in an ice bath. Serum hemoglobin was measured to eliminate samples that had concentrations greater than 15 mg%.

Analysis of serum was performed as previously described (1). Serum glutamate-oxalacetate transaminase and alkaline phosphatase were measured with commercial reagent kits manufactured by Warner Chilcott and Boehringer Mannheim, respectively.*

*Mention of commercial products is for purposes of clarity and should not be construed as an endorsement.

RESULTS

In order to present a coherent picture of the varied indices measured, the results are presented in two forms. In Figures 4 and 5 and in Table II are summarized those results which showed either a similarity or a difference between the two types of dive profiles. In the Appendices B-D, results are tabulated by individual diver. At this point, not all of these results can be explained, but in one case certain of the changes were apparently due to the onset of mumps during the exposure (6).

Figure 4 summarizes the results of serum CPK analysis obtained on all 3 profiles. It is readily apparent that the results on the three saturation-excursion dives, one at 300 FSW and two at 600 FSW, are qualitatively and quantitatively similar. Midway through the excursion phase of the dive, a 10-fold increase in mean CPK activity was observed which returned to baseline during decompression. A slight increase was apparent one or two days post-dive. In contrast, the mean CPK level fluctuated within control levels throughout the 1000 FSW dive. Lactate dehydrogenase showed a similar, but not as large increase as CPK. Glutamate-oxalacetate transaminase and amylase activities did not appear to change as a result of the hyperbaric exposure.

Serum lactic acid levels increased during the bottom time on the 600 and 1000 foot profiles (Figure 5). The elevation was correlated to some extent with the depth, the greatest elevation being observed at the 1000 FSW depth.

Serum glucose was depressed slightly during the hyperbaric exposure at 600 FSW (Table II). As in the other biochemical determinations, the changes were transient and returned to baseline during the decompression.

The other biochemistries measured, including lipoprotein distribution, neutral lipid distribution, and phospholipid distribution, did not change as a result of hyperbaric exposure (Appendices B-D).

DISCUSSION

To discuss the changes observed on these dives adequately, it is necessary to define all the stresses that could affect the divers. During all dives, there is a psychological component that will vary from individual to individual, depending on experience, attitude and the type of dive being performed. Although some changes in the biochemical constituents of serum have been attributed to psychological stresses (7), we have either not measured these constituents or not attempted to correlate psychological stress with the changes observed. Instead, we have tried to correlate those changes with the physical stresses encountered and to determine the usefulness of serum chemistries in assessing the severity of these physical stresses.

The identification of the stresses as entities is not difficult. However, the combination of one stress followed by two or more others concurrently is more difficult to interpret. The individual parameters would be rate and extent of compression, exercise, excursion dives, including both compression and decompression, immersion and finally decompression. The 1000 FSW dive eliminated several of these variables completely and minimized others. The compression rate was, for example, slow (in 200 foot increments) and there were no excursions providing repetitive cycles of compression and decompression.

In contrast, the exercise level on the 1000 foot dive was much greater than on the 300 and 600 FSW dives reported earlier. Additionally, the duration was longer and the final saturation pressure was deeper.

Of the serum constituents measured, the biggest contrast between the 1000 FSW saturation dive and the 300 and 600 FSW saturation-excursion dives was in serum CPK activity. While in the saturation-excursion dives the mean CPK level increased tenfold during the bottom phase of the dive, there was no change in CPK in any of the samples on the saturation dive. During the bottom time, divers on the 300 and 600 FSW dives were exposed to several wet excursion cycles daily. No changes in CPK activity were seen in any of the three profiles in the sample obtained 24 hours after the start of compression. Compression, at the rate performed on these dives, presumably cannot account for the subsequent elevations in the serum CPK. Additionally, exercise at high pressure does not seem to be a contributing factor since the amount of exercise was much greater on the 1000 foot dive where no changes were observed. CPK activity. Of all the stresses that have been identified, distinguished, only the repeated cycle of compression and decompression during the excursions would seem responsible for the increased CPK. To test this hypothesis further, it would be necessary to perform similar analyses on non-saturation dives repeated several times daily. Additionally, saturation dives to 600 FSW without excursions or exercise would lend insight into the causative stress.

An increased level of serum enzyme is generally attributed to tissue damage resulting in release of cellular enzymes into plasma. Analysis of one or several enzymes can frequently identify the tissue damaged. CPK is an enzyme which is primarily present in cardiac and skeletal muscle. It seems logical, therefore, that elevations in this enzyme activity in serum are a result of trauma to either cardiac or skeletal muscle. It further suggests that, although no clinical signs of decompression sickness were observed, repeated stress caused sufficient damage to skeletal and/or cardiac muscle to result in an elevation in serum levels of CPK. Serum LDH activity also increased similarly to CPK. However, the magnitude of the change was much less. LDH isoenzyme distribution was not significantly influenced by this change. This was not unexpected as the total activity remained within a "normal" range.

The elevations of serum lactic acid levels may represent a combination of several effects. Although exercise can produce elevations of serum lactate, it is unlikely that an elevation would persist during the six hour overnight rest period. Increased lactate production could also result from increased glycogenolysis subsequent to epinephrine secretion. However, secretion of epinephrine generally raises both lactate and glucose levels in blood. Since we noted an apparent decrease in serum glucose, it would seem that epinephrine could not be the sole determinant in elevating serum lactate.

Other possible metabolic alterations that could account for increased lactate include tissue hypoxia. Tissue hypoxia would result in increased lactate production concomitant with oxidization of reduced pyridine nucleotides. The bradycardia noted by Salzano (9) on deep dives could cause such a relative tissue hypoxia by reducing muscle blood flow. Both blood flow measurements and arterial oxygen content measurements at depth would be desirable to further examine these possibilities.

One further explanation is that the time between venipuncture and separation of serum was sufficient to allow substantial production of lactic acid by erythrocytes. The blood samples were placed immediately into an ice bath to slow metabolic reactions, but no metabolic inhibitors were used in order that the greatest number of constituents could be measured. With this observation, future studies should be designed to have either (a) in-chamber separation of serum, or (b) in-chamber precipitation of whole blood. The measurement of serum pyruvate would give further insight into these possible mechanisms.

The decrease in glucose observed on this dive is similar to that observed by Vorosmarti, *et al*. (3,4). That is, all in-dive samples were lower than baseline, but still within a clinically acceptable range. These authors noted no pressure dependence in this phenomenon at depths up to 600 FSW, nor did we at depths up to 1000 FSW. Future investigations should be aimed at confirming this observation and attempting to determine the cause. Since serum glucose is significantly affected by hormonal control, the underlying mechanism could be a change in hormone secretion as a response to stress.

In summary, of the various constituents monitored during these exposures, three appear to suggest alterations in the physiological status of the diver. Increase in creatine phosphokinase suggests that either overt tissue damage occurred, or that the permeability of muscle membrane to CPK increased. The increases in lactic acid concentration and decrease in glucose concentration suggest altered carbohydrate metabolism during hyperbaric exposure. Although the changes observed do not suggest that overall performance or safety are endangered, they have provided the basis for subsequent investigations (8).

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TABLE I

RATE OF DECOMPRESSION
FROM SATURATION EXPOSURES
ON HELIUM-OXYGEN

DEPTH (Feet Sea Water)	RATE* (Feet per Hour)
Initial 30 foot ascent	10
1000 - 200	6
200 - 100	5
100 - 50	4
50 - Surface	3

* Decompression is interrupted daily between 1400 and 1600 hours and between 0000 and 0600 hours.

TABLE II

SERUM GLUCOSE LEVELS DURING
HYPERBARIC EXPOSURE

Sample	300 FSW Dive	600 FSW Dive	1000 FSW Dive
Pre Dive	81 ± 15 (8)'	105 ± 11 (24)	101 ± 11 (15)
Bottom	86 ± 6 (12)	97 ± 14 (33)	99 ± 9 (32)
Decompression	88 ± 10 (16)	94 ± 7 (29)	100 ± 7 (16)
Post Dive	89 ± 13 (4)	103 ± 12 (17)	100 ± 6 (7)

' $\bar{x} \pm$ S. D. (N)

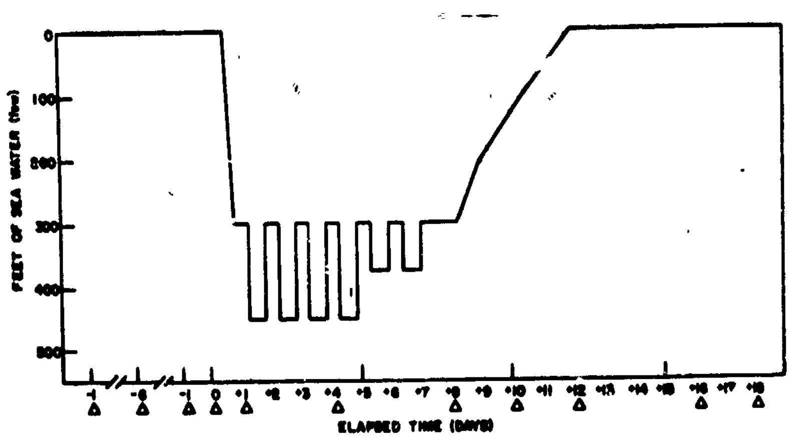

FIGURE 1

Profile of 300 FSW saturation-excursion dive. Triangles indicate days on which blood samples were obtained.

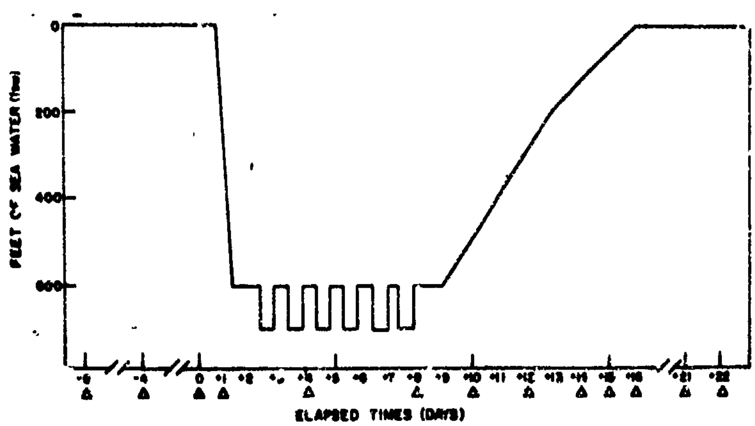

FIGURE 2

Profile of 600 FSW saturation-excursion dive. Triangles indicate days on which blood samples were obtained.

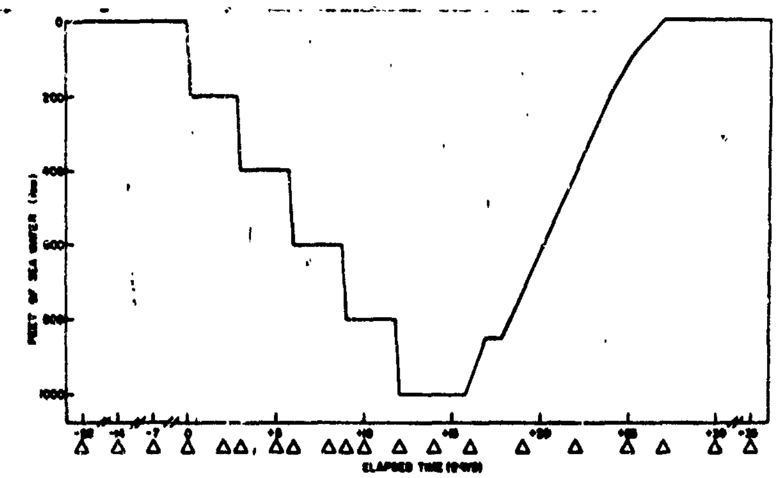

FIGURE 3

Profile of 1000 FSW saturation dive. Triangles indicate days on which blood samples were obtained.

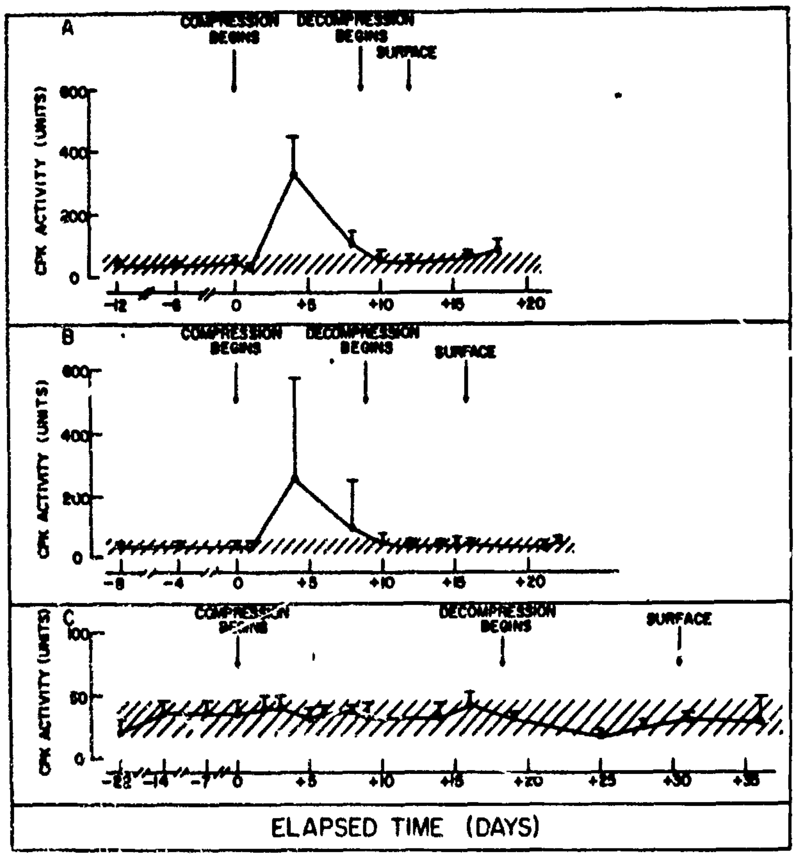

FIGURE 4

Serum CPK Levels during Hyperbaric Exposure

Each point represents the mean $\pm$ 1 S.D. for all divers on that dive. The shaded area is the mean $\pm$ 1 S.D. for all pre-dive control values. A, B, and C are the 300 FSW saturation-excursion dive, the 600 FSW saturation-excursion dive, and the 1000 saturation dive, respectively.

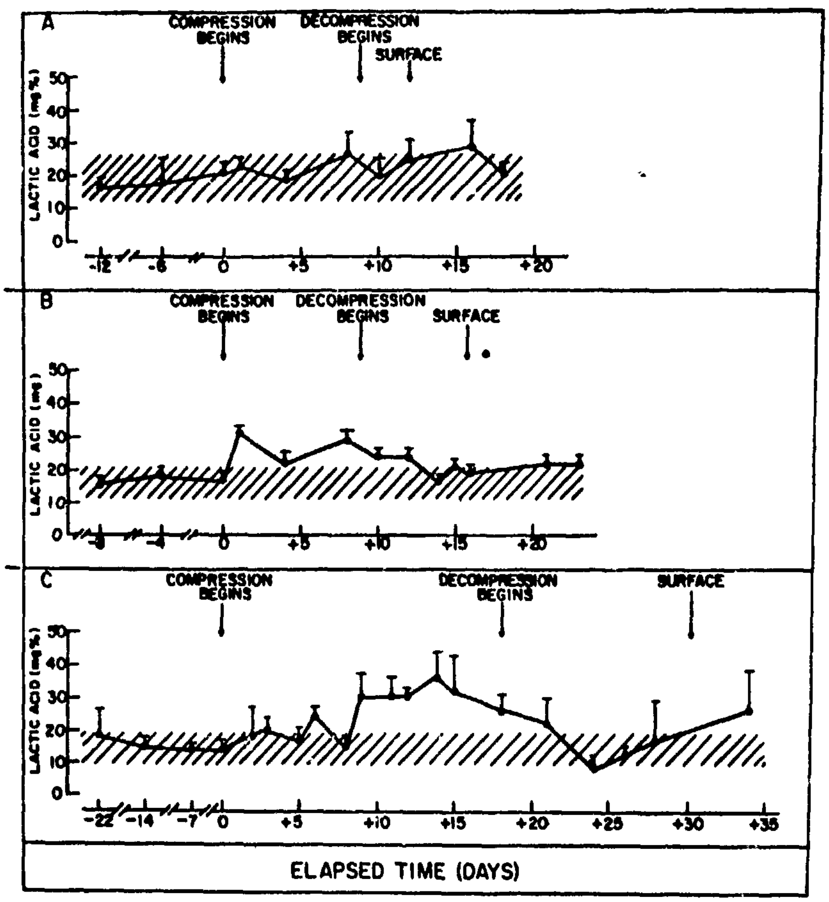

FIGURE 5

Serum Lactic Acid Levels during Hyperbaric Exposure

Each point represents the mean ± 1 S.D. for all divers on that dive. The shaded area is the mean ± 1 S.D. for all pre-dive control values. A, B, and C are the 300 FSW saturation-excursion dive, the 600 FSW saturation-excursion dive, and the 1000 FSW saturation dive, respectively.

APPENDIX A

DESCRIPTIVE PHYSICAL DATA ON DIVERS

NAME	AGE	HEIGHT	WEIGHT	CLASS	YEARS OF EXPERIENCE
A. 300 FSW Saturation Excursion Dive					
Gramm	29	64	159	1st	6
Medina	26	66 1/2	175	1st	5
Evans	33	70	187	1st	1
Conyers	23	70 3/4	157	1st	2
B. 600 FSW Saturation Excursion Dive					
Gray	37	71 1/2	169	1st	12
Larimore	27	66 1/2	230	1st	3 1/2
Miller	27	69	197	1st	3
Wilson[1]	32	72 1/2	200	1st	8
Eubanks	23	74	224	1st	5
Guzicki	27	73 1/4	195	1st	5
Lewis	36	67	191 3/4	1st	6
Roan	31	64 1/2	162	1st	5
C. 1000 FSW Saturation Dive					
Alexander	30	73	210	SMO[2]	2
Brown	32	71	186	1st	5 1/2
Majendie	36	67 1/2	175	Officer	6
Guzicki	27	73 1/4	195	1st	5

[1] Diver who developed mumps after compression

[2] Submarine Medical Officer

APPENDIX B

Individual Summaries of Serum

Biochemistries by Diver for 300 FSW Saturation-Excursion Dive

DIVER: Evans

Determination		PRE-DIVE 1 1-14-70	2 1-20-70	3 1-26-70	BOTTOM 4 1-27-70	5 1-30-70	6 2-3-70	DECOMPRESSION 7 2-5-70	8 2-7-70	9 2-11-70	POST-DIVE 10 2-13-70
CPK	(units)	72	--	77	30	331	110	36	47	88	72
Amylase	(units)	90	--	118	89	100	72	106	111	204	182
LDH Total	(units)	64	--	70	80	85	78	58	72	73	102
Distribution of LDH isoenzymes											
LDH-1		32	--	24	31	35	30	23	24	29	23
LDH-2		28	--	33	30	31	32	32	34	33	39
LDH-3	(%)	27	--	28	26	25	28	27	31	25	32
LDH-4		7	--	8	10	9	8	15	6	9	4
LDH-5		6	--	7	4	3	3	4	5	4	2
Haptoglobin	(mg%)	113	--	143	140	161	132	122	154	161	--
Glucose	(mg%)	87	--	65	84	82	94	107	104	93	96
Lactate	(mg%)	21	--	18	19	15	20	14	27	26	20
Distribution of lipoproteins											
Alpha		21	--	39	34	37	33	26	37	32	20
Pre-Beta	(%)	30	--	20	34	33	27	13	15	30	31
Beta		50	--	41	37	42	40	62	48	37	49

DIVER: Conyers

Determination		PRE-DIVE 1 1-14-70	PRE-DIVE 2 1-20-70	PRE-DIVE 3 1-26-70	BOTTOM 4 1-27-70	BOTTOM 5 1-30-70	BOTTOM 6 2-3-70	DECOMPRESSION 7 2-5-70	DECOMPRESSION 8 2-7-70	DECOMPRESSION 9 2-11-70	POST-DIVE 10 2-13-70
CPK	(units)	27	44	52	39	347	138	53	56	52	110
Amylase	(units)	154	178	72	124	127	118	106	111	146	200
LDH Total	(units)	46	53	52	56	84	84	45	67	65	49
Distribution of LDH isoenzymes											
LDH-1		34	23	37	37	34	28	34	33	35	29
LDH-2		30	33	26	28	28	34	32	32	32	35
LDH-3	(%)	23	30	25	22	24	30	24	26	24	28
LDH-4		6	4	7	9	10	6	7	7	7	8
LDH-5		7	10	5	4	4	3	4	3	2	1
Haptoglobin	(mg%)	118	115	97	129	111	102	104	132	102	--
Glucose	(mg%)	86	88	60	86	82	72	90	86	73	71
Lactate	(mg%)	13	11	17	21	19	21	14	17	14	12
Distribution of lipoproteins											
Alpha		34	36	36	39	27	30	20	38	39	22
Pre-Beta	(%)	27	19	26	24	38	31	15	25	25	34
Beta		39	45	39	37	25	39	52	38	27	45

DIVER: Gramm

Determination		PRE-DIVE			BOTTOM			DECOMPRESSION			POST-DIVE
		1	2	3	4	5	6	7	8	9	10
		1-14-70	1-20-70	1-26-70	1-27-70	1-30-70	2-3-70	2-5-70	2-7-70	2-11-70	2-13-70
CPK	(units)	21	34	31	15	464	75	40	46	49	64
Amylase	(units)	118	142	72	115	72	109	115	93	129	200
LDH Total	(units)	46	55	66	57	93	68	44	56	47	61
Distribution of LDH isoenzymes											
LDH-1		28	22	13	32	26	28	29	26	28	27
LDH-2		33	34	35	30	29	32	33	31	33	36
LDH-3	(%)	26	24	26	24	34	27	22	28	27	31
LDH-4		7	10	16	9	9	8	12	10	9	3
LDH-5		7	10	10	6	3	5	4	4	--	4
Haptoglobin	(mg%)	222	261	211	226	207	236	204	229	229	--
Glucose	(mg%)	96	102	67	85	96	92	95	88	81	89
Lactate	(mg%)	16	24	28	25	24	45	34	38	49	22
Distribution of lipoproteins											
Alpha		47	40	48	44	41	48	32	44	42	31
Pre-Beta	(%)	10	19	15	23	14	16	24	10	20	10
Beta		44	41	37	33	45	36	51	47	38	59

DIVER: Medina

Determination	PRE-DIVE 1 1-14-70	2 1-20-70	3 1-26-70	BOTTOM 4 1-27-70	5 1-30-70	6 2-3-70	DECOMPRESSION 7 2-5-70	8 2-7-70	9 2-11-70	POST-DIVE 10 2-13-70
CPK (units)	23	--	48	32	177	103	96	63	62	108
Amylase (units)	--	--	--	160	136	100	160	149	139	209
LDH Total (units)	52	--	55	69	80	68	108	57	44	47
Distribution of LDH isoenzymes										
LDH-1	39	--	29	32	32	31	28	27	36	35
LDH-2	26	--	34	28	33	32	32	33	33	32
LDH-3 (%)	22	--	27	24	27	26	27	28	23	26
LDH-4	7	--	5	8	7	8	8	7	6	4
LDH-5	6	--	5	9	2	4	5	5	3	4
Haptoglobin (mg%)	82	--	75	93	90	74	75	86	72	--
Glucose (mg%)	--	--	--	86	84	90	80	79	86	101
Lactate (mg%)	--	--	--	28	17	22	19	16	28	27
Distribution of lipoproteins										
Alpha	28	--	34	42	26	35	32	27	34	35
Pre-Beta (%)	20	--	16	22	34	19	24	20	20	12
Beta	53	--	50	36	40	46	51	48	46	54

APPENDIX C

Individual Summaries of Serum

Biochemistries for 600 FSW Saturation-Excursion Dive

Abbreviations of Neutral Lipids:

TG = triglyceride
CE = cholesterol esters

Abbreviations of Phospholipids:

LPC = lysophosphatidyl choline
SPH = sphingomyelin
PC = phosphatidyl choline
PI = phosphatidyl inositol
PE = phosphatidyl ethanolamine
PC = glycerol
CA = cardiolipin
PA = phosphatidic acid

DIVER: Wilson

Determination		PRE			BOTTOM				DECOMPRESSION				POST		
	SAMPLE	1	2	3	4	5	6*	7	8	9	10	11	12	13	14**
	DATE	11-24	11-26	12-1	12-2	12-5	12-7	12-9	12-11	12-13	12-15	12-17	12-19	12-22	1-6
CPK	(units)	128	63	43	38	145	920	275	66	21	16	16	25	27	18
Amylase	(units)	120	100	330	275	195	152	152	112	153	166	195	112	50	--
LDH Total	(units)	49	47	49	49	50	140	91	73	59	54	49	48	41	51
Distribution of Isoenzymes															
LDH-1		31	35	37	27	25	[illegible]	18	26	30	39	29	36	28	36
LDH-2		27	20	29	20	28	37	31	32	35	30	34	35	37	28
(%) LDH-3		29	31	26	26	35	40	42	35	26	30	26	22	24	24
LDH-4		8	11	--	11	8	4	5	3	6	8	6	4	5	7
LDH-5		4	3	8	17	4	5	4	4	3	3	5	4	6	4
Total Protein	(Gm%)	5	8	8	8	6	8	8	8	-	8	7	8	8	8
Haptoglobin	(mg%)	169	169	162	173	267	347	480	366	-	264	243	208	175	185
Glucose	(mg%)	119	118	117	119	120	99	130	100	108	105	110	107	85	---
Lactate	(mg%)	10	12	12	22	17	24	18	18	17	23	14	26	18	---
Free Fatty Acids	(μmol/L)	1292	1694	1394	1108	991	--	877	1284	846	836	1613	1021	1429	---
Cholesterol	(mg%)	216	187	197	178	144	150	149	138	142	128	165	144	150	---
Distribution of Neutral Lipids															
Monoglyceride		1	--	1	---	1	2	1	2	1	-	2	---	---	---
Free Fatty Acids		6	--	14	---	11	7	5	7	4	7	6	---	---	---
(%) Cholesterol		19	--	17	---	20	17	18	17	16	18	23	---	---	---
Diglyceride		2	--	2	---	2	2	2	2	2	2	1	---	---	---
TG/CE		72	--	64	---	67	72	73	73	77	72	68	---	---	---
Distribution of Phospholipids															
LPC		7	11	10	11	7	9	8	9	11	10	9	13	---	---
SPH		25	21	21	28	26	27	23	26	20	24	23	23	---	---
PC		58	56	55	52	61	61	54	51	55	55	62	51	---	---
(%) PI		3	4	--	---	---	---	4	3	---	---	3	---	---	---
PE		7	8	8	10	5	3	8	3	6	8	6	5	---	---
PG		--	--	--	---	---	---	---	---	---	---	---	---	---	---
CA		--	--	--	---	---	---	---	---	---	---	---	---	---	---
PA		--	--	--	---	---	---	---	---	---	---	---	---	---	---
Distribution of Lipoproteins															
ALPHA		41	46	46	43	34	37	37	34	31	32	27	25	46	41
(%) PRE-BETA		24	21	28	18	19	26	20	34	32	28	41	49	39	20
BETA		35	33	26	39	47	37	44	33	38	40	32	27	26	40

* Acute phase specimen

** Convalescent specimen

DIVER: Eubank

Determination	SAMPLE DATE	PRE 1 12-22	2 12-29	3 1-6	BOTTOM 4 1-7	5 1-10	6 1-14	DECOMPRESSION 7 1-15	8 1-18	9 1-20	10 1-22	POST 11 1-23	12 1-26	13 1-30
CPK	(units)	30	60	53	48	175	51	85	55	--	59	63	55	63
Amylase	(units)	100	114	72	125	124	163	100	104	--	100	117	72	72
LDH Total	(units)	48	48	56	56	67	60	66	91	--	74	89	60	81
Distribution of Isoenzymes														
LDH-1		34	32	29	33	21	36	25	33	--	28	22	34	32
LDH-2		34	32	31	31	29	30	35	30	--	31	30	31	36
(%) LDH-3		23	28	25	26	30	22	26	21	--	25	29	26	23
LDH-4		7	6	9	5	7	5	7	7	--	9	10	5	5
LDH-5		3	3	6	5	13	8	7	10	--	8	10	4	5
Total Protein	(Gm%)	8	8	8	8	8	7	8	9	--	7	8	7	8
Haptoglobin	(mg%)	158	200	179	172	197	183	168	193	--	204	193	186	193
Glucose	(mg%)	95	108	104	84	88	94	98	86	--	104	106	106	103
Lactate	(mg%)	17	26	170	38	30	32	36	32	--	24	16	28	28
Free Fatty Acids	(μmol/L)	1440	2073	626	1211	1014	1025	908	764	--	818	870	789	--
Cholesterol	(mg%)	156	177	222	218	233	192	205	210	--	270	200	187	225
Distribution of Neutral Lipids														
Monoglyceride		--	--	2	--	2	3	4	2	--	2	1	2	4
Free Fatty Acids		7	14	10	--	11	16	12	6	--	14	12	9	1
(%) Cholesterol		17	15	21	--	21	22	20	17	--	16	18	19	14
Diglyceride		2	4	3	--	4	3	3	2	--	2	1	1	1
TG/CE		74	67	65	--	62	57	61	72	--	67	6.8	70	81
Distribution of Phospholipids														
LPC		9	--	5	--	7	7	9	8	--	5	4	7	9
SPH		16	--	21	--	18	--	24	19	--	22	22	20	20
PC		46	--	60	--	58	61	52	51	--	55	50	51	54
(%) PI		4	--	--	--	1	3	3	5	--	4	8	3	4
PE		14	--	11	--	9	19	9	13	--	8	10	15	10
PG		--	--	--	--	--	2	--	1	--	1	1	--	--
CA		5	--	3	--	3	8	--	2	--	2	3	3	3
PA		4	--	--	--	3	--	--	--	--	4	3	--	--
Distribution of Lipoproteins														
ALPHA		26	32	30	33	23	27	33	25	--	31	34	35	24
(%) PRE-BETA		44	30	31	32	33	28	28	34	--	44	22	30	37
BETA		30	38	39	35	44	45	40	42	--	25	44	35	39

DIVER: Guzicki

Determination	SAMPLE	PRE 1	2	3	BOTTOM 4	5	6	DECOMPRESSION 7	8	9	10	POST 11	12	13
	DATE	12-22	12-29	1-6	1-7	1-10	1-14	1-15	1-18	1-20	1-22	1-23	1-26	1-30
CPK	(units)	24	23	40	22	120	36	34	31	34	32	35	36	60
Amylase	(units)	40	86	22	153	134	154	118	123	150	109	90	72	118
LDH Total	(units)	38	36	50	45	49	57	44	56	61	52	66	49	63
Distribution of Isoenzymes														
LDH-1		36	29	32	35	28	34	28	27	17	33	24	33	35
LDH-2		25	28	26	31	26	26	27	31	30	27	29	29	31
(%) LDH-3		26	31	32	24	26	27	27	22	32	24	27	25	25
LDH-4		10	6	6	5	10	6	12	14	14	10	12	8	5
LDH-5		2	7	3	5	10	7	6	8	8	5	9	5	5
Total Protein	(Gm%)	9	8	--	8	8	8	9	7	8	7	7	7	8
Haptoglobin	(mg%)	158	158	165	175	168	170	163	165	132	143	161	154	150
Glucose	(mg%)	96	98	96	68	88	86	86	94	77	89	95	98	105
Lactate	(mg%)	16	19	14	33	22	22	22	23	15	15	16	25	17
Free Fatty Acids	(µmol/L)	2094	1432	844	861	899	561	745	876	--	812	1003	803	--
Cholesterol	(mg%)	233	220	194	253	239	226	218	213	219	266	239	187	230
Distribution of Neutral Lipids														
Monoglyceride		1	5	--	--	3	2	2	2	--	1	2	1	--
Free Fatty Acids		5	16	9	8	10	7	8	6	7	9	11	6	--
(%) Cholesterol		15	29	21	20	28	21	19	20	20	18	19	19	--
Diglyceride		3	5	2	3	3	3	3	3	2	2	2	1	--
TG-CE		77	46	68	69	56	67	69	70	71	70	65	73	--
Distribution of Phospholipids														
LPC		12	8	7	8	9	10	8	11	10	7	7	8	11
SPH		22	18	16	19	16	14	21	20	19	21	21	19	19
PC		51	50	54	46	55	50	50	57	63	51	52	53	50
(%) PI		3	--	3	9	5	4	5	2	--	6	8	--	2
PE		9	17	14	15	13	17	14	10	9	6	10	16	9
PG		--	6	2	--	2	--	--	--	--	1	1	1	--
CA		2	--	2	3	--	5	--	--	--	4	2	3	--
PA		--	--	3	--	--	--	--	--	--	3	--	--	--
Distribution of Lipoproteins														
ALPHA		18	30	24	32	23	24	25	25	22	33	29	31	22
(%) PRE-BETA		47	32	38	38	31	28	41	31	31	44	30	28	44
BETA		35	39	37	31	46	47	34	44	87	23	41	42	34

DIVER: Lewis

Determination		PRE			BOTTOM			DECOMPRESSION				POST		
	SAMPLE	1	2	3	4	5	6	7	8	9	10	11	12	13
	DATE	12-22	12-29	1-6	1-7	1-10	1-14	1-15	1-18	1-20	1-22	1-23	1-26	1-30
CPK	(units)	23	33	28	26	67	36	28	18	---	---	30	29	32
Amylase	(units)	80	86	72	153	124	127	100	104	---	---	136	118	100
LDH Total	(units)	50	3[illegible]	55	59	37	87	51	60	---	---	79	84	57
Distribution of Isoenzymes														
LDH-1		28	40	28	29	22	29	25	18	---	---	22	19	2[illegible]
LDH-2		33	28	31	31	26	31	32	35	---	---	32	34	35
(%) LDH-3		29	18	31	30	33	27	27	28	---	---	29	34	25
LDH-4		8	10	7	5	7	10	10	12	---	---	10	9	8
LDH-5		3	5	4	5	12	4	6	8	---	---	8	4	4
Total Protein	(Gm%)	8	7	8	9	8	8	8	8	---	---	7	7	7
Haptoglobin	(mg%)	143	156	158	154	177	178	175	193	---	---	168	165	154
Glucose	(mg%)	96	101	117	98	109	92	97	98	---	---	146	110	104
Lactate	(mg%)	17	26	25	33	28	34	28	33	---	---	25	21	25
Free Fatty Acids	(μmol/L)	1524	1638	1035	888	889	805	869	574	---	---	713	678	---
Cholesterol	(mg%)	236	240	278	312	309	279	273	244	---	---	278	244	254
Distribution of Neutral Lipids														
Monoglyceride		---	1	2	1	2	2	2	---	---	---	2	1	3
Free Fatty Acids		---	13	10	8	7	10	10	---	---	---	9	5	2
(%) Cholesterol		---	26	21	22	22	15	20	---	---	---	23	17	17
Diglyceride		---	4	4	3	3	5	3	---	---	---	1	2	1
TG-CE		---	56	62	66	67	67	65	---	---	---	65	75	77
Distribution of Phospholipids														
LPC		8	---	6	6	8	8	9	---	---	---	6	6	10
SPH		18	---	13	18	20	17	18	---	---	---	21	18	23
PC		59	---	52	47	58	58	58	---	---	---	53	60	56
(%) PI		3	---	5	5	2	---	5	---	---	---	5	---	---
PE		12	---	12	15	10	8	10	---	---	---	11	14	9
PG		---	---	7	5	---	---	---	---	---	---	1	1	---
CA		---	---	2	3	3	9	---	---	---	---	3	2	2
PA		---	---	2	---	---	---	---	---	---	---	---	---	---
Distribution of Lipoproteins														
ALPHA		30	27	20	23	18	20	30	30	---	---	26	30	24
(%) PRE-BETA		41	36	45	46	43	27	33	33	---	---	32	44	32
BETA		33	38	35	32	39	53	37	37	---	---	42	27	44

DIVER: Roan

Determination		PRE			BOTTOM			DECOMPRESSION				POST		
	SAMPLE	1	2	3	4	5	6	7	8	9	10	11	12	13
Determination	DATE	12-22	12-29	1-6	1-7	1-10	1-14	1-15	1-18	1-20	1-22	1-23	1-26	1-20
CPK	(units)	31	45	38	29	266	26	33	47	40	38	49	49	35
Amylase	(units)	50	152	160	134	186	181	127	190	178	136	192	101	136
LDH Total	(units)	54	47	75	75	86	79	56	183	84	72	83	69	73
Distribution of Isoenzymes														
LDH-1		34	35	35	32	25	33	28	26	15	25	21	25	30
LDH-2		31	27	32	27	28	30	31	31	35	29	30	29	36
(%) LDH-3		30	26	23	27	28	28	27	30	31	27	27	30	24
LDH-4		3	7	5	9	10	7	8	10	10	10	10	6	7
LDH-5		2	6	5	5	9	2	6	4	10	9	12	10	2
Total Protein	(Gm%)	7	7	7	7	8	7	8	8	7	8	7	7	--
Haptoglobin	(mg%)	90	104	115	90	116	121	104	115	118	111	107	104	118
Glucose	(mg%)	85	103	97	85	77	92	92	90	91	88	104	97	100
Lactate	(mg%)	18	16	19	32	30	27	26	31	20	18	28	18	24
Free Fatty Acids	(μmol/L)	1429	1640	640	1082	1005	686	547	826	--	1217	1388	1160	--
Cholesterol	(mg%)	150	195	211	246	262	215	211	231	260	286	314	247	278
Distribution of Neutral Lipids														
Monoglyceride		--	--	--	--	2	3	4	2	2	1	2	1	3
Free Fatty Acids		--	15	11	9	14	15	9	8	7	12	15	8	5
(%) Cholesterol		--	16	19	23	26	21	16	18	21	17	22	19	16
Diglyceride		--	1	2	2	2	6	2	3	2	2	2	1	2
TG/CE		--	68	68	66	56	55	69	68	68	69	60	71	73
Distribution of Phospholipids														
LPC		--	--	6	7	11	10	10	9	8	6	5	8	7
SPH		--	--	16	21	18	19	18	16	17	19	22	19	23
PC		--	--	48	56	54	58	56	62	65	51	55	58	59
(%) PI		--	--	4	5	3	2	4	3	--	6	4	--	3
PE		--	--	12	5	11	9	9	10	9	7	9	12	7
PG		--	--	12	--	1	--	--	--	2	1	1	--	--
CA		--	--	--	--	2	3	3	--	--	4	3	2	2
PA		--	--	2	--	--	--	--	--	--	5	--	--	--
Distribution of Lipoproteins														
ALPHA		49	35	31	37	33	31	37	30	31	40	45	32	36
(%) PRE-BETA		12	22	28	19	11	17	20	29	13	24	11	20	15
BETA		39	28	42	44	57	52	43	42	56	36	45	48	49

DIVER: Larrimore

Determination	SAMPLE DATE	PRE 1 11-24	2 11-26	3 12-1	BOTTOM 4 12-2	5 12-5	6 12-9	DECOMPRESSION 7 12-11	8 12-13	9 12-15	10 12-17	POST 11 12-19	12 12-22
CPK	(units)	35	33	45	52	82	80	55	26	31	46	34	15
Amylase	(units)	--	160	96	88	56	74	100	90	74	115	128	30
LDH Total	(units)	49	53	42	53	46	72	63	64	62	79	54	53
Distribution of Isoenzymes													
LDH-1		29	26	20	38	30	23	20	22	31	26	31	28
LDH-2		30	29	32	23	32	39	34	39	32	39	32	34
(%) LDH-3		35	27	25	23	27	31	33	32	28	28	25	25
LDH-4		6	11	--	10	9	6	7	4	8	3	7	8
LDH-5		2	7	--	4	3	1	5	3	1	5	4	4
Total Protein	(Gm%)	6	7	7	7	7	7	6	--	7	7	7	7
Haptoglobin	(mg%)	158	166	166	185	181	204	240	193	172	152	158	160
Glucose	(mg%)	94	100	99	93	93	94	86	96	90	88	99	99
Lactate	(mg%)	16	13	14	27	14	20	18	16	21	12	17	12.3
Free Fatty Acids	(μmol/L)	1390	1326	863	1014	968	1198	1308	529	1173	1735	1619	1535
Cholesterol	(mg%)	167	209	213	208	204	197	179	163	156	20	179	175
Distribution of Neutral Lipids													
Monoglyceride		2	1	1	2	--	1	--	2	1	--	1	1
Free Fatty Acids		11	5	8	10	--	10	--	5	4	10	6	9
(%) Cholesterol		17	19	18	--	--	18	--	17	15	17	19	20
Diglyceride		--	2	2	2	--	2	--	2	1	2	2	2
TG/CE		67	72	71	--	--	69	--	73	78	72	72	68
Distribution of Phospholipids													
LPC		11	8	11	10	8	7	7	8	8	9	6	9
SPH		26	22	21	22	23	22	22	22	17	21	23	24
PC		50	54	48	59	55	55	54	46	45	51	56	48
(%) PI		3	7	7	9	--	4	--	5	--	4	3	--
PE		9	7	13	--	12	12	11	8	10	12	12	14
PG		--	--	--	--	--	--	2	--	--	--	--	1
CA		--	--	--	--	--	--	5	6	--	--	--	2
PA		3	3	--	--	2	--	--	5	--	3	--	2
Distribution of Lipoproteins													
ALPHA		19	33	41	31	24	21	20	14	27	22	27	32
(%) PRE-BETA		37	45	32	32	31	30	48	27	29	38	34	30
BETA		44	22	27	38	46	49	32	60	44	40	39	38

DIVER: Gray

Determination	SAMPLE / DATE	PRE 1 11-24	2 11-26	3 12-1	BOTTOM 4 12-2	5 12-5	6 12-9	DECOMPRESSION 7 12-11	8 12-13	9 12-15	10 12-17	POST 11 12-19	12 12-22
CPK	(units)	24	14	19	29	989	305	72	24	29	19	--	--
Amylase	(units)	--	120	122	104	56	93	79	98	145	133	--	--
LDH Total	(units)	46	50	49	56	88	74	53	56	49	50	--	--
Distribution of Isoenzymes													
LDH-1		24	25	23	--	22	18	23	25	29	28	--	--
LDH-2		29	25	37	--	26	29	33	37	26	33	--	--
(%) LDH-3		36	33	34	--	35	39	26	27	32	26	--	--
LDH-4		8	11	--	--	11	11	9	6	9	9	--	--
LDH-5		3	7	6	--	6	2	9	6	4	4	--	--
Total Protein	(Gm%)	7	7	7	7	7	7	6	--	7	7	--	--
Haptoglobin	(mg%)	162	146	131	185	184	172	183	218	161	143	--	--
Glucose	(mg%)	112	111	98	107	99	102	89	99	91	94	--	--
Lactate	(mg%)	13	11	14	32	15	16	14	14	17	13	--	--
Free Fatty Acids	(µmol/L)	954	1691	1253	880	1050	653	919	1095	799	1207	--	--
Cholesterol	(mg%)	193	255	250	234	207	223	189	188	178	20	--	--
Distribution of Neutral Lipids													
Monoglyceride		2	--	1	--	1	3	2	2	2	--	--	--
Free Fatty Acids		9	11	4	10	9	6	5	5	4	7	--	--
(%) Cholesterol		20	--	19	--	27	20	25	18	19	20	--	--
Diglyceride		3	--	2	--	1	--	2	3	1	2	--	--
TG/CE		66	--	75	--	61	71	67	73	75	71	--	--
Distribution of Phospholipids													
LPC		12	10	8	--	8	21	8	7	8	8	--	--
SPH		28	21	--	--	21	56	23	24	19	21	--	--
PC		49	6	--	44	66	5	56	42	54	52	--	--
(%) PI		2	6	--	7	--	14	--	9	4	--	--	--
PE		7	14	11	10	5	2	9	10	10	11	--	--
PG		--	--	--	--	--	3	1	2	--	3	--	--
CA		--	--	4	--	--	--	2	4	3	3	--	--
PA		2	--	--	--	--	--	--	3	1	2	--	--
Distribution of Lipoproteins													
ALPHA		14	27	37	27	25	34	35	23	20	26	--	--
(%) PRE-BETA		30	35	23	25	20	18	25	25	20	34	--	--
BETA		56	39	40	49	55	49	40	53	60	39	--	--

DIVER: Miller

		PRE			BOTTOM			DECOMPRESSION				POST	
	SAMPLE	1	2	3	4	5	6	7	8	9	10	11	12
Determination	DATE	11-24	11-26	12-1	12-2	12-5	12-9	12-11	12-13	12-15	12-17	12-19	12-22
CPK	(units)	30	35	30	42	--	175	54	40	21	29	--	26
Amylase	(units)	--	140	131	72	--	93	112	107	150	150	--	120
LDH Total	(units)	52	61	58	60	--	81	92	59	58	62	--	59
Distribution of Isoenzymes													
LDH-1		21	32	22	28	--	24	24	26	26	32	--	49
LDH-2		38	28	32	25	--	33	33	42	34	35	--	33
(%) LDH-3		33	27	26	30	--	33	30	41	28	23	--	10
LDH-4		8	12	21	13	--	7	8	9	9	7	--	5
LDH-5		6	1	--	4	--	3	5	1	2	3	--	4
Total Protein	(Gm%)	7	8	7	7	--	7	7	--	7	8	--	8
Haptoglobin	(mg%)	166	166	166	204	--	179	229	211	200	175	--	170
Glucose	(mg%)	125	123	107	113	--	121	100	98	99	89	--	90
Lactate	(mg%)	16	17	16	20	--	22	20	17	32	20	--	25
Free Fatty Acids	(μmol/L)	1017	1663	1109	1660	--	1026	1364	1045	1600	1284	--	1429
Cholesterol	(mg%)	210	221	204	195	--	204	172	168	169	167	--	181
Distribution of Neutral Lipids													
Monoglyceride		2	--	1	1	--	1	1	2	2	2	--	--
Free Fatty Acids		6	--	5	9	--	7	10	7	7	17	5	--
(%) Cholesterol		23	--	13	20	--	17	17	17	16	21	17	--
Diglyceride		2	--	1	3	--	1	2	4	2	1	2	--
TG/CE		67	--	31	68	--	72	70	70	72	68	76	--
Distribution of Phospholipids													
LPC		9	9	10	8	--	8	7	8	10	10	10	--
SPH		20	24	24	25	--	20	20	21	24	25	22	--
PC		51	54	53	48	--	58	54	49	51	58	54	--
(%) PI		6	5	--	8	--	--	5	3	--	--	3	--
PE		11	7	11	11	--	13	13	10	9	7	11	--
PG		3	--	--	--	--	--	--	--	--	--	--	--
CA		--	--	3	--	--	2	--	4	5	--	--	--
PA		--	--	--	--	--	--	--	3	--	--	2	--
Distribution of Lipoproteins													
ALPHA		22	40	36	33	--	24	33	29	28	34	--	32
(%) PRE-BETA		27	22	31	26	--	38	26	23	30	26	--	43
BETA		51	39	33	41	--	38	41	48	42	40	--	34

APPENDIX D

Individual Summaries of Serum Biochemistries for 1000 FSW Saturation Dive

DIVER: Alexander

SAMPLE		DATE	CPK units	LDH units	AMYLASE units	SGOT units	ALK PHOS units	HAPTO-GLOBIN mg%	GLU-COSE mg%	LAC-TATE mg%	CHOLES-TEROL mg%	LDH ISOENZYMES 5	4	3	2	1
												% distribution				
Pre	1	6/2/70	34	65	136	40	1.9	73	98	12	200	6	0	39	36	19
	2	6/8/70	44	58	53	--	2.1	83	87	14	196	4	2	35	30	28
	3	6/15/70	31	48	104	27	2.0	92	103	13	170	2	4	30	39	25
	4	6/22/70	40	44	131	45	1.8	90	110	12	230	2	1	33	33	30
Bottom	5	6/24/70	31	42	145	40	1.8	--	104	12	173	-	-	--	--	--
	6	6/25/70	33	49	100	29	1.7	--	106	14	162	-	-	--	--	--
	7	6/27/70	30	60	144	35	2.1	130	86	14	192	2	5	42	22	30
	8	6/28/70	33	67	163	44	2.1	141	89	23	190	3	8	39	21	31
	9	6/30/70	35	56	133	37	1.7	108	106	15	210	2	4	32	34	29
	10	7/1/70	19	52	142	44	2.2	75	104	23	186	4	12	27	24	34
	11	7/3/70	--	57	172	53	---	86	112	23	218	1	6	41	27	25
	12	7/4/70	--	56	127	23	---	91	108	31	175	2	5	33	34	27
	13	7/6/70	19	62	80	35	2.2	106	---	34	188	4	9	49	18	20
	14	7/8/70	48	60	134	28	---	97	---	25	198	2	6	34	29	29
Decomp																
	15	7/11/70	27	72	145	27	2.3	87	98	23	186	3	5	31	33	29
	16	7/14/70	--	53	90	23	---	--	106	17	198	1	5	33	36	25
	17	7/17/70	12	50	114	26	2.4	140	101	9	197	1	5	47	25	23
	18	7/19/70	26	52	139	26	2.3	155	93	14	188	2	5	41	23	30
Post	19	7/22/70	29	51	114	33	2.5	159	103	9	187	4	13	22	21	41
	20	7/27/70	18	42	124	22	1.9	195	100	11	176	3	0	53	16	29

DIVER: Brown

SAMPLE		DATE	CPK units	LDH units	AMYLASE units	SGOT units	ALK PHOS units	HAPTO-GLOBIN mg%	GLU-COSE mg%	LAC-TATE mg%	CHOLES-TEROL mg%	LDH ISOENZYMES 5	4	3	2	1
												% distribution				
Pre	1	6/2/70	12	56	145	30	1.3	173	89	27	189	5	4	38	33	20
	2	6/8/70	29	54	98	--	1.1	213	98	20	207	3	1	27	35	34
	3	6/15/70	19	51	114	20	1.5	239	107	14	203	2	2	41	31	24
	4	6/22/70	20	46	169	37	1.4	167	107	17	206	2	5	31	36	27
Bottom	5	6/24/70	51	51	145	46	1.2	---	103	32	210	-	-	--	--	--
	6	6/25/70	55	44	127	22	1.1	---	112	27	214	-	-	--	--	--
	7	6/27/70	42	64	200	26	1.1	225	91	21	190	5	6	32	29	29
	8	6/28/70	31	65	163	35	1.3	249	92	27	177	1	3	44	23	29
	9	6/30/70	46	62	169	33	1.1	216	112	19	196	1	7	35	37	20
	10	7/1/70	45	85	133	34	2.3	194	96	37	181	2	11	30	30	28
	11	7/3/70	--	67	163	44	---	195	105	30	190	3	3	27	29	37
	12	7/4/70	--	56	90	39	---	209	105	30	203	4	7	32	31	27
	13	7/6/70	44	54	110	33	1.4	208	---	47	206	7	3	11	49	18
	14	7/8/70	53	70	143	29	1.4	179	---	49	138	4	2	38	29	28
Decomp	15	7/11/70	30	63	136	19	1.4	194	109	28	120	3	5	37	30	25
	16	7/14/70	--	53	119	18	1.7	194	112	33	142	3	4	31	33	28
	17	7/17/70	9	49	96	20	1.2	262	100	13	126	1	5	47	25	23
	18	7/19/70	20	52	120	22	1.5	311	100	16	154	5	4	41	20	30
Post	19	7/22/70	29	57	160	23	2.6	252	104	31	162	7	9	34	25	25
	20	7/27/70	20	42	133	26	1.0	273	100	23	165	2	0	52	19	28

DIVER: Guzicki

SAMPLE		DATE	CPK units	LDH units	AMYLASE units	SGOT units	ALK PHOS units	HAPTO-GLOBIN mg%	GLU-COSE mg%	LAC-TATE mg%	CHOLES-TEROL mg%	LDH ISOENZYMES % distribution 5	4	3	2	1
Pre	1	6/2/70	21	59	145	34	1.2	154	87	15	169	3	6	49	23	21
	2	6/8/70	25	41	80	--	1.3	211	114	12	242	2	2	31	29	36
	3	6/15/70	38	44	57	24	1.2	189	100	15	218	4	4	42	30	21
	4	6/22/70	33	35	122	30	1.1	152	104	12	226	1	5	38	28	28
Bottom	5	6/24/70	30	54	127	39	---	---	97	16	207	-	-	--	--	--
	6	6/25/70	35	44	136	19	1.1	---	94	19	228	-	-	--	--	--
	7	6/27/70	26	54	136	24	1.1	223	90	13	213	3	3	49	21	25
	8	6/28/70	32	65	163	30	1.3	235	88	21	215	2	3	52	19	24
	9	6/30/70	36	44	142	26	1.3	255	94	13	210	1	4	32	36	27
	10	7/1/70	32	65	[illegible]	26	1.3	207	83	24	196	1	17	31	25	25
	11	7/3/70	--	64	145	31	---	189	102	28	214	1	5	31	32	31
	12	7/4/70	--	48	118	24	---	209	87	34	212	4	9	41	25	22
	13	7/6/70	32	66	80	27	1.3	202	--	29	248	1	3	51	23	22
	14	7/8/70	27	72	126	29	1.6	202	--	26	216	4	3	39	30	24
Decomp	15	7/11/70	31	60	136	24	1.6	198	92	21	204	2	4	40	31	24
	16	7/14/70	17	45	109	22	1.6	183	90	14	208	3	10	35	28	23
	17	7/17/70	24	53	131	22	1.5	202	96	6	201	2	7	41	28	23
	18	7/19/70	--	53	139	22	1.5	211	89	10	192	4	7	58	21	9
Post	19	7/22/70	37	57	114	25	1.7	257	97	11	200	2	6	36	27	29
	20	7/27/70	19	39	205	20	1.3	254	87	33	200	2	0	48	24	26

DIVER: Majendie

SAMPLE		DATE	CPK units	LDH units	AMYLASE units	SGOT units	ALK PHOS units	HAPTO-GLOBIN mg%	GLU-COSE mg%	LAC-TATE mg%	CHOLES-TEROL mg%	LDH ISOENZYMES % distribution 5	4	3	2	1
Pre	1	6/2/70	--	--	--	--	--	---	---	--	---	-	-	--	--	--
	2	6/8/70	40	50	106	38	1.2	209	101	14	266	2	1	30	36	31
	3	6/15/70	42	63	86	--	1.9	158	87	15	233	3	6	36	30	25
	4	6/22/70	37	50	131	65	1.3	168	122	15	235	1	1	35	38	24
Bottom	5	6/24/70	43	43	145	53	1.2	151	109	14	184	-	-	--	--	--
	6	6/25/70	39	50	136	31	1.1	156	108	18	214	-	-	--	--	--
	7	6/27/70	30	56	163	38	1.2	202	82	19	196	2	4	33	25	37
	8	6/28/70	39	65	163	57	1.3	223	87	27	223	2	4	49	20	25
	9	6/30/70	36	62	169	41	1.1	169	103	14	225	1	4	37	33	25
	10	7/1/70	36	75	150	41	1.4	131	104	35	221	5	10	27	27	32
	11	7/3/70	--	59	172	40	---	139	105	38	238	-	-	--	--	--
	12	7/4/70	--	68	145	29	---	---	93	31	238	3	3	32	31	31
	13	7/6/70	36	79	100	37	1.4	133	---	34	214	-	-	--	--	--
	14	7/8/70	41	68	206	23	1.4	138	---	28	220	4	5	34	30	27
Decomp	15	7/11/70	39	70	182	28	1.6	129	99	33	209	1	4	34	34	27
	16	7/14/70	--	58	110	26	1.4	130	106	25	212	3	5	33	36	25
	17	7/17/70	21	51	140	28	1.6	182	105	9	189	3	3	47	23	25
	18	7/19/70	29	55	158	29	1.5	196	100	14	173	1	4	46	22	27
Post	19	7/22/70	--	--	--	--	---	---	---	--	---	-	-	--	--	--
	20	7/27/70	60	54	171	30	1.1	253	106	38	186	2	-	50	20	29

APPENDIX E

Summary of Clinical Findings

A. 300 FSW Saturation-Excursion Dive

1. No symptoms were reported by the divers during any phase of the dive.

B. 600 FSW Saturation-Excursion Dive

1. No symptoms were reported during compression.
2. Larrimore reported knee pain and gastrocnemius pain at the 185 foot stop. The pain was treated with oxygen but not with pressure. The pain was resolved by the fourth 30 minute exposure to 21% oxygen.
3. Wilson developed mumps on the second day of the dive. A complete report is presented elsewhere (6).

C. 1000 FSW Saturation Dive

1. No problems were reported on compression.
2. Alexander reported dull knee pain which first occurred at 400 feet. At 185 feet he was treated with oxygen with only slight improvement. The pain was completely resolved within 2 days after surfacing.